Using the Bio-Monitor to Determine Heart Rate

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Electronic monitoring devices are increasingly accessible classroom tools. A variety of compact and inexpensive machines is available to measure physiological responses in human and animal subjects. One type of equipment measures the bioelectrical potentials generated by the contractions of cardiac muscle. Such biopotentials use natural pathways provided by electrolytes present in all body tissues; they can, therefore, be measured effectively at sites such as the skin surface of the wrist. Basically, this type of device is a millivolt amplifier that produces both audible and visible signals that represent heart muscle contractions.

We have used such a device, the Bio-Monitor, for demonstration and experimentation during the past school year. We proceeded as follows:

1. Clean the ventral side of the subject's wrists with isopropanol.
2. After drying, apply a small amount of electrode gel or paste, provided with the Bio-Monitor, to the contact areas.
3. Also apply the gel to two plate electrodes.
4. Attach the electrodes to the wrists with flexible straps and connect the electrode cables between the electrodes and the Bio-Monitor.
5. Turn on the machine and wait about ten seconds for a clear signal.

The audible "bleep" can be heard easily throughout the average-size classroom, and the flashing light is visible from the rear of the room. The Bio-Monitor is powered by a battery, which makes it quite convenient to use.

On rare occasions, the Bio-Monitor did not pick up a discernible signal from a subject. According to the manufacturer, this happens because a small percentage of the population produces a low-voltage signal that is difficult to detect. Most of the failures we experienced were, however, caused by improper technique.

Student Use of the Bio-Monitor

One student who was interested in studying the effects of various stimuli on heart rate borrowed the Bio-Monitor. After establishing a subject's mean heart rate, the student monitored the subject's response to various stimuli. These stimuli were a sour liquid; a loud unexpected noise; irritation to the skin; and exciting photographic images. The student also used fear stimuli (such as placing a live tarantula near the subject) during the experiment.

The student-experimenter had no problems either learning to operate or using the instrument. In fact, this particular student found a large number of willing subjects for his

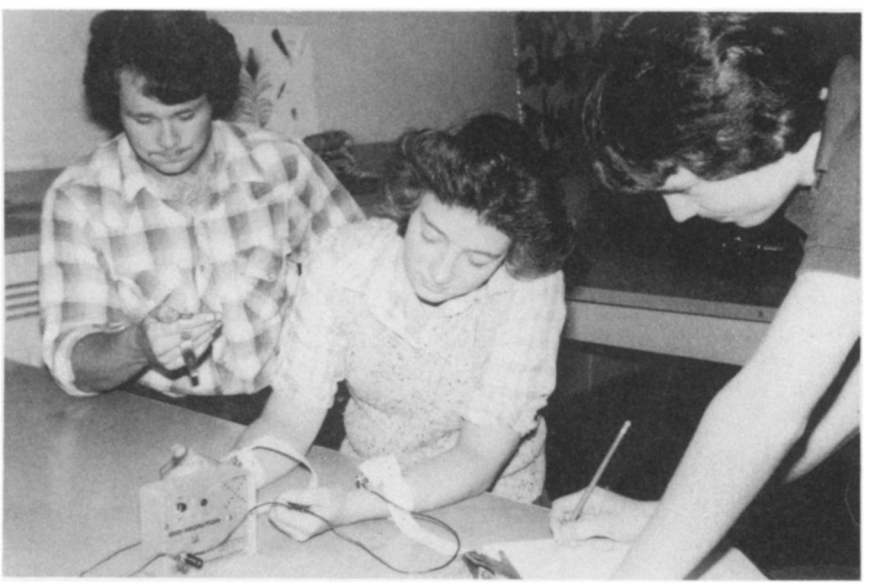

FIGURE 1. Students using the Bio-Monitor to test the normal heart rate of a subject.

project because the other students were intrigued by the monitor.

The manual that accompanies the Bio-Monitor suggests additional exercises, including monitoring electromyographic signals from facial and arm muscles, studying the effect of various respiratory activities on heart rate (Polynea or rapid breathing, breath-holding, and re-breathing into a paper bag), observing the effects of exercise on heart rate, and testing the consequences of using drugs such as caffeine and atropine.

Using the instrument is completely safe, though many subjects feel somewhat anxious when they are connected by wires to the unfamiliar machine. This soon wears off, however. I had no apprehension when I used the Bio-Monitor to measure the comparatively rapid heart rate of my nine-month-old daughter.

It should be noted that the Bio-Monitor does not measure heart abnormalities and is not a diagnostic tool. Nevertheless, the instrument is an exciting addition to the biological or behavioral laboratory. It is a challenge to devise new ways to use it. One avenue that we did not explore during the trial period is the obvious use of the Bio-Monitor in studying biofeedback.

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Nutrition Studies With Earthworms

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Compared to most laboratory animals, earthworms are simple to care for and require little space. Thus, they are practical subjects for simple nutrition studies.

Those earthworms most suited for nutrition studies are *Lumbricus rubellus* and *Eisenia foetida*, the common red worms used for fishing. These worms breed constantly throughout the year, and an adequate breeding stock for nutrition studies can be kept in a small box at room temperature, either in the classroom or laboratory. The actual nutrition studies with adult or baby worms can be conducted in petri dishes, also kept at room temperature.

The experiments described below will demonstrate how different diets affect the growth rate of earthworms. The experiments may be conducted by one student or by several teams of students using different diets. Prior to the experiments, however, the teacher should discuss nutrition in general and introduce students to the different classes of nutrients, refer to their occurrence in different foods consumed by humans, and outline health problems caused by nutrient deficiencies or inadequate nutrition. Teachers should also cover the differences between essential and nonessential nutrients. A suitable outline for such a presentation is provided by Vredeveld (1977) and an outstanding source of information on nutrition and food production is *The Scientific American* (235:3, September 1976).

Materials Needed

An inexpensive MicroEcosystem produced by Jewel Industries of Chicago and available through some of the biological supply companies can be used to maintain a year-round supply of worms for nutrition studies and for a wide variety of other experiments, which are described in the manual accompanying the equipment. Obtain one of these MicroEcosystems (which includes earthworms, bedding, feed, and the lab manual); or substitute a plastic container (about 20 x 20 x 6 cm). Half-fill the container with moist peat moss. Add about 25 adult red worms obtained from biological supply houses or other sources to the container. If baby worms are desired, adult earthworms should be obtained at least one month before the experiments will start because it will take that long for baby worms to become available. Once established, however, a breeding stock of earthworms provides a constant supply of baby worms for nutrition studies and other experiments.

You will also need the following equipment: